

NORFOLK ISLAND'S CADDISFLY IS A NEW ZEALANDER (TRICHOPTERA: HYDROPTILIDAE)

ALICE WELLS¹ and KARL KJER²

¹Australian National Insect Collection, CSIRO, PO Box 1700, Canberra, ACT 2601
(Email: alice.wells@csiro.au)

²Department of Entomology and Nematology, UC Davis, Davis CA 95616, USA
(Email: kkjer@ucdavis.edu)

Abstract

Triplectides australis Navás, a leptocerid species reported in 1917 from a single specimen but not collected since, and *Oxyethira albiceps* (McLachlan), the microcaddisfly species reported here, are the only caddisflies ever recorded from Norfolk Island. This impoverished trichopteran fauna is discussed and compared with the notably endemic faunas of Lord Howe Island and New Caledonia, the two other major islands on the Norfolk Ridge of the southwestern Pacific. Comparisons of COI data confirm the initial morphology-based identification of the Norfolk Island microcaddisfly as a New Zealand species.

Introduction

The first record of Trichoptera for Norfolk Island was of a single female reported by Tillyard (1917) as the ‘... very common Australian species ...’ *Notanatolica magna* Walker, 1852. Subsequently, this was considered by Hawkins (1943) to be a misidentification for *Triplectides cephalotes* (Walker, 1852). However, in their review of the genus *Triplectides* Kolenati, 1859, Morse and Neboiss (1982) identified Tillyard’s specimen as a different, also common Australian species, *Triplectides australis* Navás, 1934. Smithers (1998) also listed it as *Triplectides australis*. We have been unable to locate the specimen in collections of either the South Australian Museum or Museum Victoria, the two most likely depositories. Until now, Tillyard’s specimen represented the only trichopteran reported from Norfolk Island. Here we report on another trichopteran species, taken by light trapping. This was the only species taken at light over the years 2012-2015, which suggests that the *Triplectides* species could simply have been an adventive, or may have become extinct.

On both Norfolk Island and Lord Howe Island, the more southerly and smaller of the set of islands on the southwestern Pacific Norfolk Ridge, permanent running water is scarce, in contrast with New Caledonia to their north. Norfolk Island and Lord Howe Island are approximately 35 km² and 15 km² in size, respectively; both are eroded volcanoes and have very few permanent to semi-permanent streams and few still-water bodies. In contrast, the far larger New Caledonia (area 18,575 km²), with its central massif from which numerous streams arise, has a rich, highly endemic Trichoptera fauna: the current total is 239 species, most of which are endemic (Johanson and Wells, in prep.). Nonetheless, for Lord Howe Island, seven endemic Trichoptera species have been described and life stages of at least three other species have been reported (Wells 2011). Yet from Norfolk Island, despite repeated light trapping recently at several of the permanent lotic and lentic

water bodies, only a single species was taken. This is a microcaddisfly (Hydroptilidae), not the leptocerid species that was recorded previously for the island. In this present study, the identification based on morphological features is tested by comparisons of COI data from Norfolk Island specimens with data from New Zealand material (BOLD 2015).

Norfolk Island's environment has a bleak post-European settlement history. Clearing of vegetation for horticulture and agriculture, pollution of the ground water systems (see Abel and Falkland 1991, Diatloff 2007), invasion by weeds (NIQS 2014) and physical damage caused by cattle, have resulted in the severe degradation of the few waterways (*e.g.* Figs 1-2). Just how many of the small number of aquatic species listed by Smithers (1998) as having been recorded from the island currently live and breed there is unknown. Among Odonata, Smithers listed two species of Coenagrionidae and two Anisoptera; among Hemiptera: Hydrometridae (1) and Velidae (1); among Coleoptera: Gyrinidae (2) and Hydrophilidae (2); among Diptera: Tipulidae (at least 5), Culicidae (4), Ceratopogonidae (7) and Simuliidae (1); and in Lepidoptera one unidentified species of Nymphulinae (= Crambidae). If comparisons with Lord Howe Island with its smaller size and considerable level of endemism among Trichoptera have any validity, it seems probable that very early following the settlement of the island by Europeans in March 1788, even before the first insects were recorded for Norfolk Island, the island's aquatic habitats were probably severely impacted, resulting in loss of species (see Abel and Falkland 1991, Diatloff 2007, Coyne 2011).



Figs 1-2. Cockpit Falls Reserve was one of the collecting sites where, over the years 2012-2015, cattle roamed freely: (1) the stream was choked along some reaches by water hyacinth (*Eichhornia crassipes*); (2) elsewhere damaged severely by cattle; and just a little further upstream of these sections was choked by a thicket of taro (*Colocasia esculenta*) and bullrushes (*Typha* sp.).

Over the years 2012 to 2015, a quarantine survey of plant and animal species of Norfolk Island was conducted. The survey concentrated primarily on

invasive species of flora, pathogens and fauna, targeting particularly groups of agricultural and quarantine concern. For some groups, comprehensive species lists were developed (e.g. weedy plants – NIQS 2014; Thysanoptera – Mound and Wells 2015). Mound and Wells (2015) found that around 50% of the 66 thrips species they took on the island are adventives; six species were recorded that were described originally from New Zealand; and 12 species were recorded as endemics. Among the island's flora of some 183 vascular plant species, 43 endemics are recorded (Coyne 2011). The collection of Trichoptera samples was an adjunct to the survey.

Methods

Light-trap specimens were collected into and stored in 95% ethanol. Specimens are deposited in the Australian National Insect Collection (ANIC), CSIRO, Canberra, Australia. Initial species determination was made by examination of slide mounts prepared by maceration in caustic potash, dehydration and clearing in clove oil, followed by mounting in Canada balsam. Ten male specimens were selected for barcoding, their genitalia removed and prepared as Canada balsam-mount vouchers (ANIC).

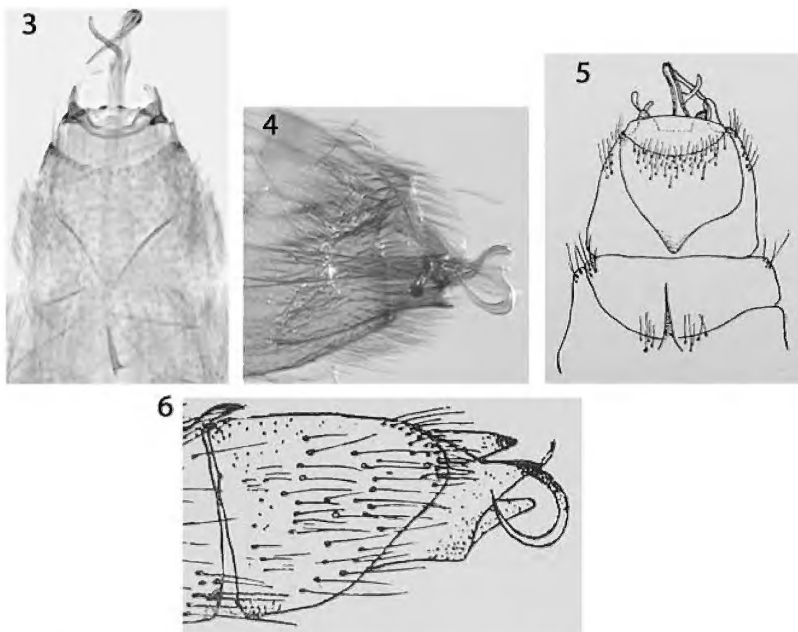
We collected mitochondrial DNA data from a fragment of cytochrome oxidase, subunit 1 (COI; the barcode fragment), using standard Folmer primers (Folmer *et al.* 1994), as modified in Zhou *et al.* (2009). DNA was extracted with the "Hotshot" method (Truett *et al.* 2000) and PCR was performed using standard protocols (Zhou *et al.* 2009). Amplified DNA was commercially purified and sequenced in both strands at Genewiz (Piscataway, New Jersey). Trace files were manually trimmed and edited. Sequences were submitted to the BOLD website for identification (http://www.boldsystems.org/index.php/IDS_OpenIdEngine). Identifications were made based on the phylogenetic tree option.

Results

All of the Trichoptera specimens taken (more than 500, including males and females) were identified as belonging to a single microcaddisfly species, *Oxyethira albiceps* (McLachlan, 1862) (identification confirmed by Brian Smith pers. comm., based on morphological information – Figs 3-6 allow comparison of the Norfolk Island specimens with copies of the figures that accompanied the original description, reproduced from Mosely and Kimmins 1953). This species is widely distributed and common in New Zealand on the three main islands (North, South and Stewart Islands) and also occurs on Snares, Antipodes, Auckland, Campbell and Chatham Islands (McMurtrie *et al.* 2014); its larvae feed on filamentous green algae and the species is known to be tolerant of enriched waters.

Amplification of DNA from Norfolk Island specimens was successful for 7 of the 10 Norfolk Island specimens extracted (Table 1). Comparison of the resulting sequences revealed that three of the specimens were identical with

data available through the BOLD site for *Oxyethira albiceps* from Waikato, in the upper northern part of the North Island of New Zealand. Similarity of four others ranged between 99.4% and 99.8%. Thus, our data fail to indicate any significant difference between the two populations.



Figs 3-6. (3-4) Norfolk Island *Oxyethira albiceps* (McLachlan, 1862) male genitalia (BOLD voucher #06): (3) ventral view; (4) lateral view. (5-6) New Zealand *O. albiceps* holotype male genitalia: (5) ventral view; (6) lateral view (modified after Mosely and Kimmins 1953).

Discussion

In contrast with the two other islands of the Norfolk Ridge, Norfolk Island appears to have no endemic Trichoptera species. Conceivably, the only species in the water bodies sampled, the hydroptilid *Oxyethira albiceps*, colonised waterways that were devoid of Trichoptera until efforts were made quite recently to reduce the severe pollution described by Diatloff (2007). The species could even have persisted in the degraded systems from earlier times, since *O. albiceps* tends to be tolerant of enriched waters (see Lavender *et al.* 2004). Comparison of COI data from Norfolk Island and New Zealand supports a very recent association, not ruling out repeated colonisation. It is possible that colonisation occurred as it has by other insect species and possibly still occurs, either by chance dispersal on the south-east trade winds

(Holloway 1982) or through human traffic. In contrast with New Zealand's other caddisfly species (around 200 described species), its ubiquity, abundance and tolerance of high nutrient levels in streams would make *O. albiceps* an ideal candidate for establishment on Norfolk Island.

Table 1. Similarity (in %) between the Norfolk Island sample of *Oxyethira albiceps* (McLachlan, 1862) and specimens from Waikato in the North Island of New Zealand (NZ data accessed from BOLD courtesy of Ian Hogg).

Norfolk Island Site	BOLD voucher #	Similarity (%) with NZ Waikato (Data from BOLDSYSTEMS 2015)
Cascade Falls (= Cockpit Reserve)	AWNICAD15NI-01	100
Cascade Falls (= Cockpit Reserve)	AWNICAD15NI-02	99.5
Bombora Creek, Bombora Reserve	AWNICAD15NI-03	100
Stream on Selwyn Rd	AWNICAD15NI-05	100
Stream on Selwyn Rd	AWNICAD15NI-06	99.7
Cascade Falls (= Cockpit Reserve)	AWNICAD15NI-07	99.8
Kingston, Millpond	AWNICAD15NI-10	99.4

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